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FUEL BATTERY

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## Detailed Report

## 1. Name of invention

Fuel Battery

## 2. Sphere of patent request

In the field of batteries which consist of a laminated gas-separating plate, fuel cell, electrolyte matrix, and oxidizing electrode in that order, this invention is concerning a battery which has the characteristic that the catalyst reaction layer is arranged after reducing water-propelling feature on the surface of substrate of the fuel battery and oxidizing agent electrode.

## 3. Detailed explanation of invention

This invention is concerning a battery. Especially, it is concerning the construction of its electrode.

The structure of an electrode for a conventional battery is shown in the figure. In the figure, / indicates the entire electrode. (in this case, it is assumed that both fuel pole

and oxidizing pole have the same structure) It consists of a catalyst reaction layer 2, electrode substrate 3, and wet seal 4.

Next, the construction of the electrode is explained. The electrode substrate 3 is a thin, porous carbon plate approximately 450  $\mu\text{m}$  thick which is usually called carbon paper. However, to prevent penetration of the electrolyte from the electrolyte matrix of the fuel cell, this carbon paper is given a water-repellent treatment using a fluorine based polymer (for example, polytetrafluoro ethylene). After this treatment, a wet seal 4 is formed by filling it with mixture of silicon carbide (SiC) and polytetrafluoroethylene. After this, a catalyst paste which consists of catalyst and polytetrafluoro ethylene is applied in the center. The electrode is completed by sintering it at about 330°C. In this kind of electrode, for example, hydrogen which is the active gas flows in from the electrode substrate 3 side. It reacts at the catalyst layer, and it supplies positive ions to the electrolyte in the electrolyte matrix which is in front of and also in contact with it. At the same time, it supplies electrons to the external lead source.

Since the former electrode has the construction described above, water-repellent treatment using a water based catalyst paste cannot be done smoothly on the surface of electrode substrate during application of the catalyst reaction layer. The opposite surface which comes in contact with the catalyst reaction layer has problems with high contact resistance with gas separating plate since the water-repellent polymer attached to the surface is electrically insulating.

This invention was made to solve these former problems. Its object is to offer a battery with a uniform catalyst layer and an electrode with small contact resistance. It uses a process which removes the water-repellent polymer from the surface before the catalyst layer is applied to the electrode substrate which had undergone water-repellent treatment.

The water-repellent treatment of the electrode substrate is an unavoidable step in producing a gas diffusion electrode. Accordingly, after treatment by water-repellent polymer, the surface of electrode can be plasma treated to remove several  $\mu\text{m}$  of the polymer from the surface. Representative plasma processing conditions use argon plasma formed at 0.2 to 0.8 Torr, and 20 to 200 X microwave input. Since plasma treatment is done under these conditions, it affects only the surface of the electrode substrate. It does not penetrate the electrode substrate to undo its water-repellent feature. Therefore, an electrode substrate which is given this treatment will be easier to coat with catalyst since the water-repellent feature is reduced on its surface. In addition, contact resistance with the separator will be lower.

Furthermore, although this example uses argon plasma, the same effects can be produced using nitrogen or another inert gas plasma as well.

As stated above, by plasma treating the surface of the electrode substrate which has undergone the water-repellent treatment, the water-repellent feature of the surface is reduced. The catalyst layer of the electrode can be applied uniformly. In addition, it reduces contact resistance with the gas separating plate.

#### 4. Simple explanation of figures

The figure is a cross section of the electrode of a battery.

- 1: electrode
- 2: catalyst layer
- 3: electrode substrate
- 4: wet seal